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KNOWLEDGE ACQUISITION FOR AN EXPERT SYSTEM AT RETAIL STOCK POINTS

by

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Knowledge Acquisition for an Expert System at Retail Stock Points

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The job of the retail inventory manager at NAVSUP stock points is laborious and complex. The expertise required to perform the job normally takes years to obtain. Improvements in productivity and training are possible through the application of so-called "expert systems" programming. This thesis presents the decision-making methodology of experts as they perform two common time consuming tasks of a Navy stock point inventory manager--Delinquent Dues and Variable Ranking List processing. Delinquent Dues Listings alert the inventory manager to potential problem requisitions which are well past their estimated delivery date. Variable Ranking Lists highlight a number of situations requiring inventory manager review, the most common being National Stock Numbers (NSNs) with an excessive amount on order. A narrative, flowcharts, and a summary of inventory manager decision rules for these two functions are provided. Building on the recording of these knowledge factors, the potential for an expert system prototype is suggested.

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I. INTRODUCTION

A. THE PROBLEM

Retail inventory management at the Naval Supply Systems Command's (NAVSUP) various stock points is currently a highly labor intensive process. In spite of advancements in information systems technology, the retail item manager's on-line access to information is still inadequate. Too frequently, he must resort to time consuming manual effort in order to obtain needed data and process transactions.

Moreover, the job of the item manager is itself quite complex. Positioned at the retail level in the Navy's multi-echelon supply support system, he is tasked with managing a large number (often 2000-3000) of individual National Stock Numbers (NSNs) to meet customer demand from a specific geographic area. He truly occupies an intermediate position between the customer who submits his requisition at the nearest Point of Entry (POE) and the Inventory Control Point (ICP) that manages items on a worldwide basis.

The individual item manager's responsibility may encompass a wide range of cognizance symbols, or "cogs," the supply system's indicator of the particular NSN's ICP and material type. His daily routine may require liaison with the Defense Logistics Agency (DLA), the General Services Administration (GSA), the Navy Ships Parts Control Center

(SPCC), the Navy Aviation Supply Office (ASO), or any of the other services' ICPs, each with some unique procedures and ways of doing business.

In addition to this external environmental complexity, the Uniform Automated Data Processing System-Stock Point (UADPS-SP), the Navy-wide system for stock point supply management, imposes its own demands on the user. It requires mastery of a large number of data files and manual aids. The acquisition of sufficient knowledge to perform adequately is a laborious process, usually requiring several years of on-the-job training and close managerial supervision.

In the current atmosphere of budgetary constraints and end strength cutbacks, NAVSUP must find a way to process its ever increasing workload more efficiently than before. One challenge is to improve the throughput capacity and information access of the retail inventory manager without significantly increasing expenditures.

B. BACKGROUND

The recent development of commercial artificial intelligence software that can assimilate and mimic the decision making of experts offers the potential for overcoming NAVSUP's efficiency and productivity problems at the retail level. Such an "expert system" would take advantage of the ongoing program to augment the UADPS-SP operating environment with numerous programmable workstations at the individual inventory manager's desk.

How does one define an expert system? An expert system is a computer program that incorporates the knowledge and experience of the most adept practitioners in a particular field, thereby disseminating that scarce expertise more widely and consistently than was previously possible. Expert systems are particularly appropriate in advising technicians on repetitive problems within a narrow but intensive domain of knowledge. [Ref. 1]

An expert system is considerably more complex than the standard computer program. If a body of knowledge can be readily codified in a step-by-step algorithm, there is little need for an expert. An expert system is called for in areas where the knowledge base is often subjective or intuitive. A heuristic "rule of thumb" approach is particularly conducive to modelling by an expert system. The expert system uses these rules of thumb in a format of "If . . . then . . ." statements for programming [Ref. 2]. In order to ascertain the rule that applies to a particular situation, the expert system asks a series of questions of the user, whose answers, in turn, prompt more questions, eventually leading to a system recommendation.

One must keep in mind that the approach of two different experts in the same field may vary considerably. There may be no "right" answer, but instead a number of potentially fruitful approaches to a problem which will result in a satisfactory answer. The designer of an expert system must

work closely with one or more experts to elicit the detailed knowledge factors and decision rules they use to perform their jobs so effectively. This requires examining often unspoken assumptions for their logical bases, and walking through numerous examples of work processing at the most minute and time consuming level of detail. If one expects a program to emulate an expert's decisions, all aspects of that decision process must be understood and recorded in a thorough fashion. [Ref. 3]

The retail inventory manager's job functions appear, at first glance, to be legitimate candidates for expert systems development. The tasks are usually repetitive in nature. They are performed by journeymen technicians rather than by supervisory or managerial personnel. These tasks do, however, require a considerable amount of expertise which is not easily or quickly absorbed by the novice. As in most fields of knowledge, some diversity of opinion on particular issues is encountered among experts. Accordingly, there seems to be an opportunity for significant paybacks from the application of sophisticated artificial intelligence programming techniques.

C. THESIS OBJECTIVE

NAVSUP is sponsoring this research with the ultimate goal of developing a functioning expert system for use at its stock points. The first step is to develop a prototype

that can be evaluated for effectiveness and cost. At the Naval Postgraduate School, research in expert systems has evolved into a cooperative effort involving students and faculty from the curricula of inventory management and information systems, and is divided into several discrete parts. This thesis is the first to result from the ongoing research. Its objective is to record and elucidate the knowledge factors and decision rules used by retail inventory managers in several limited job tasks. Subsequent theses are expected to evolve a prototype expert system based on the expert knowledge recorded here.

D. APPROACH

The approach taken in the research has been to visit Navy stock points and interview, in detail, practicing inventory managers. A research team made a preliminary, exploratory trip to Naval Supply Center (NSC) Oakland in September, 1986. The purpose of this trip was to familiarize the team members with the retail inventory manager's job, and to determine the best areas for further investigation. Two trips were then made to NSC San Diego in September and November 1986. As a consequence of these visits, the research team selected two job functions for initial study. The end product desired was a detailed profile of the item manager's decision making process in these selected areas.

E. SCOPE

Detailed study through interviews was concentrated on the computer related operations called "Delinquent Dues Processing," (UADPS-SP Program Number B-UA52) and the "Variable Ranking Program," (UADPS-SP Program Numbers H-UA64 and H-UA65). The criteria for selection were that the interface function required of an inventory manager be time consuming as currently worked, and require considerable inventory manager expertise.

F. PREVIEW

Chapter II will present an analysis of the expert item manager's approach to processing Delinquent Dues. Both a narrative and flowcharts are provided. Chapter III will take a similar approach in describing the Variable Ranking List Program. The purpose of the narrative in Chapters II and III is to provide the definitions, context, and background that will make the flowcharts and decision rules completely understandable. The flowcharts provide a step-by-step description of the decision process. A summary of decision rules is provided at the end of each chapter. These rules record the essence of the item manager's methods in "if . . . then . . ." statements. They are provided in a format that has been used in the development and programming of functioning expert systems [Ref. 2]. They are

included to aid subsequent research. Chapter IV will provide a summary and recommendations for further research.

II. DELINQUENT DUES PROCESSING

A. INTRODUCTION

Navy retail inventories are managed and positioned close to their intended customers. This allows the Navy supply system to minimize its response time to fleet demands. Navy retail item managers at a stock point are typically responsible for a number of different cogs, not all of which are managed by Navy ICPs. An essential part of the management of an individual NSN is replenishment, the process by which the item manager reorders new stock to replace that which has been issued. The item manager must ensure that he has assets arriving in the logistics pipeline tomorrow to replace that which he issues to customers today. Requisitions for replenishment stock which have not yet been received are known as dues, because they are "due-in" at some future time.

The validity of outstanding dues is a continual concern to the item manager. The effective management of dues, which requires the purging of no longer valid requisitions for retail stock, helps ensure better customer support and accurate financial ledgers. Carrying requisitions as outstanding when the material will, in fact, never be taken up in stock point records, needlessly ties up scarce stock fund dollars and puts the item manager in a precarious

position with respect to the solidity of his assets. After replenishment, dues management is probably the most important task of the item manager.

This chapter will present an overview of the Delinquent Dues Listing, and a narrative describing its processing. Flowcharts are included to aid reader understanding. Finally, the expert item manager's methodology is distilled into 33 decision rules in the form of "if . . . then . . ." statements.

B. THE DELINQUENT DUES LISTING

The Delinquent Dues Listing, a product of UADPS-SP program B-UA52, is a monthly report which must be manually reviewed by the item manager. Figure 1 is a page from a Delinquent Dues Listing. It is segregated by groups of over-age increments, which are determined by the original or revised Estimated Delivery Date (EDD). If neither an original nor revised EDD is available, the requisition date plus 30 days is used for continental United States (CONUS) activities. Within each age group category, the report is in descending dollar value sequence, broken down by account and cognizance code. The Extended Money Value (EMV) is rounded off to the nearest whole dollar.

The keys to working the report are the various age group categories (AGC in Figure 1), which are defined as follows:

PROGRAM NO. UA52 DELINQUENT DUE LISTING-FOR LOCALLY CONTROLLED MATERIAL OTHER THAN TECHNICAL COGS 860516

DOC ID	R I	S C	A C	AC CC	NSN	UI	QTY	DOC NR	U F	L S	ITEM ADDR	S A	F C	PRO	REV OR EDD	P R I	R I	P U R	CALL/ ORDER	MSIR UP	EMV	B/L TCN	A G C	S H PDATE
DUS	NDZ	F		9DIA7530010652409		RD	00125	N0024460210814			N68621	JJ3		770	6041	08	NDZ	A		0000001465	0000001831		4	6135
DUS	NDZ	F		9QIA7420011745217		EA	00012	N0024460121303				J3		770	6032	08	NDZ	A		0000015000	0000001800		4	6135
DUS	NDZ	F		9QLA8115007384575		EA	00022	N0024460121407			N68621	JJ3		770	6032	08	NDZ	A		0000002450	0000000539		4	6135
DUS	NDZ	F		9DIA7430011262998		EA	00025	N0024460161039				J3		770	6036	08	NDZ	A		0000001750	0000000438		4	6135
DUS	NDZ	F		9QLA6505LL0000129		BT	00214	N0024484A3636			000001	DJ3		770	6024	15	NOZ	A	WA63	0000000000	0000000000		4	6135
DUS	NDZ	F		9DIA7195002245190		EA	00025	N0024460303125			N63196	JJ3		770	6050	08	NOZ	A		0000019600	0000004900		3	6135
DUS	NDZ	F		9QIA7195002245190		EA	00025	N0024486MRA22			000001	DJ3		770	6059	15	NDZ	A		0000010980	0000002745		3	6135
DUS	NDZ	F		9QIA7530009356554		HD	02000	N0024486FGB27			000001	DJ3		770	6072	08	NDZ	A		0000000105	0000002100		3	6135
DWV	GSA	F		9DGA7350010128787		BX	00053	N0024460400893			YSTDCK	AJ3		770	6057	15	NDZ	A	X25	0000002881	0000001527	GS0001BP9817007	3	B0000
DUS	NDZ	F		9DKA6230001376394		SE	00022	N0024460280850				J3		770	6058	15	NDZ	A		0000006600	0000001452		3	6135
DWV	GSA	F		9DJA8040001334394		SF	00952	N0024452694517			YSTDCK	AJ3		770	6065	15	NDZ	A	X25	0000000150	0000001428	0024452694517XX	3	B0000
DWV	GSA	F		9QGA5140003315496		EA	00078	N0024460441578			YSTDCK	AJ3		770	6057	15	NDZ	A	X25	0000001697	0000001324	GS0001BP9817007	3	B0000
DUS	NDZ	F		9QLA5640002350255		BD	00090	N0024484A3438			000001	DJ3		770	6056	15	NDZ	A	PB44	0000001096	0000000986		3	6135
DUS	NDZ	F		9DLA8105011242838		EA	00080	N0024486MRA23			000001	DJ3		770	6066	08	NDZ	A		0000001200	0000000960		3	6135
DUS	N32	F		9DLA5120002743782		EA	00010	N0038386PL758			0001AB	S			6074	00	NDZ	A		0000006900	0000000690		3	6135
DWV	GSA	F		9QJA8040001334394		SF	00399	N0024452924154			YSTDCK	AJ3		770	6065	15	NDZ	A	X25	0000000150	0000000599	0024452924154XX	3	B0000
DWV	GSA	F		9QGA6230005118828		EA	00065	N0024460303115			YSTDCK	AJ3		770	6051	15	NDZ	A	R	0000000758	0000000493	0024460303115XX	3	B0000
DWV	GSA	F		9DGA8010007219748		PT	00336	N0024460441643			N63196	JJ3		770	6059	15	NDZ	A	X25	0000000097	0000000326	GF0002BQ7290553	3	B0000
DUS	NDZ	F		9QLA5120008921977		EA	00001	N0024460351203				J3		770	6055	08	NDZ	A		0000022000	0000000220		3	6135
DUS	NDZ	F		9QLA8010001116306		GL	00008	N0024460280861				J3		770	6058	15	NDZ	A		0000002255	0000000180		3	6135
DUS	NDZ	F		9QLA5130002773096		EA	00007	N0024460441568				J3		770	6074	15	NDZ	A		0000002230	0000000156		3	6135
DUS	NDZ	F		9QLA8040007148223		TU	00050	N0024460280864				J3		770	6058	15	NDZ	A		0000000245	0000000123		3	6135
DUS	NDZ	F		9QLA8010009221157		KT	00004	N0024460231419				J3		770	6053	15	NDZ	A		0000002750	0000000110		3	6135
DUS	NDZ	F		9QIA7910008171385		EA	00024	N0024460280859				J3		770	6058	15	NDZ	A		0000000380	0000000091		3	6135
DWV	GSA	F		9DGA5305000150980		HD	00013	N0024460351221			YSTDCK	AJ3		770	6050	15	NDZ	A	X25	0000000293	0000000038	GA0004U4A579845	3	50000
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DWV	GSA	F		9DGA5310008892765		BX	00006	N0024460400872B			YSTDCK	AJ3		770	6057	15	NDZ	A	X25	0000000255	0000000015	0024460380970DX	3	G0000
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DWV	GSA	F		9QGA8010009172256		CN	00396	N0024460383060E			NG3196	JJ3		770	6104	08	NDZ	A	X25	0000005762	0000022818	N0024460383060C	2	B0000
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DUS	NDZ	F		9QGA7530007675708		BX	00500	N0024485FGF73			000001	DJ3		770	6080	08	NDZ	A		0000000523	0000002615		2	6046
DUS	NDZ	F		9QLA7430LL0000496		EA	00130	N0024485MMH56			000001	DJ3		770	6087	08	NDZ	A		0000001751	0000002276		2	6135
DUS	NDZ	F		9DLA5680007276371		EA	00005	N0024486MPC22			000001	DJ3		770	6100	15	NDZ	A		0000033525	0000001676		2	6135
DWV	GSA	F		9DGA5130009357354		EA	00046	N0024460833004			YSTDCK	AJ3		770	6100	15	NDZ	A	R	0000003201	0000001472	GF0001BQ7302970	2	B0000
DUS	NDZ	F		9QLA5120007599568		EA	00008	N0024486MTC89			000001	DJ3		770	6097	15	NDZ	A		0000017891	0000001431		2	6135
DWV	GSA	F		9DGA5120000828528		EA	00174	N0024452831055			YSTDCK	AJ3		770	6079	15	NDZ	A	X25	0000000576	0000001002		2	6135
DWV	GSA	F		9DGA9905005504118		EA	00347	N0024460711545			YSTDCK	AJ3		770	6085	15	NDZ	A	X25	0000000240	0000000833	00244607115455XX	2	90000
DUS	NDZ	F		9QLA5180008167455		EA	00002	N0024486MCA18			000001	DJ3		770	6089	15	NOZ	A		0000040000	0000000800		2	6135
DUS	NDZ	F		9DLA5120008921977		EA	00003	N0024460561332				J3		770	6076	08	NDZ	A		0000022000	0000000660		2	6135
DWV	GSA	F		9DGA5120002248950		EA	00096	N0024460922383			YSTDCK	AJ3		770	6104	15	NDZ	A		0000000405	0000000389	GA0004BP4979787	2	B0000
DUS	NDZ	F		9QLA5130009483360		EA	00001	N0024484A2369			000001	DJ3		770	6077	08	NDZ	A	TC39	0000031725	0000000317		2	6135
DWV	GSA	F		9QGA7930002829700		DR	00001	N0024460331448			YSTDCK	AJ3		770	6082	15	NDZ	A		0000028702	0000000287		2	6135
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DWV	GSA	F		9DGA5133001899246		DZ	00046	N0024460691717			YSTDCK	AJ3		770	6079	15	NDZ	A	X25	0000000459	0000000211	0024460691663XX	2	G0000

Figure 1 Sample Delinquent Due Listing

CODE	NO. OF DAYS OVERDUE
1	1-30
2	31-60
3	61-90
4	91-120
5	121-180
6	180

An automated card (known as a 9J Exception) is provided for each delinquent due with an age group category code of 3 or greater. The greatest item manager attention must be devoted to dues in the oldest categories. In practice, those in categories 1 and 2 are not reviewed.

C. PROCESSING THE LISTING

The rule that the item manager follows can be simply stated as follows: classify the requisition as an invalid due when a combination of age and/or unsatisfactory supply status convinces one that further efforts to chase the document will be futile. When that point is reached can differ from one item manager to the next. Where the expert excells is in his depth of knowledge, and his sometimes uncanny ability to make sense of a baffling series of status reports. What follows may give the impression that Delinquent Dues processing is more systematic than is actually the case. It should be recognized that current procedures are less definitive and uniform than the following flowcharts. Some item managers undoubtedly process the report differently. What the following attempts to capture are the thought processes and decision rules used by the expert. The reader

should refer to Figures 2 through 6 to aid in understanding the narrative.

Figure 2 illustrates the start of the process. The initial step is to obtain the latest status on the outstanding due. This information is available from several sources, some more current or updated more frequently than others. The KB90H program is a local NSC San Diego dues program that provides a list of all dues on a weekly basis. A real time alternative is status obtained from the UADPS-SP Receipt Due File (a so-called Frame XVI retrieval). For a 9 cog item, an inquiry of the DLA remote terminals may provide the very latest status on items managed by DLA ICPs.

As Figure 2 indicates, as long as some supply status is available from one of the above mentioned sources, a number of questions and decisions are possible for the item manager, depending on what that status is. A BA (item being processed for release and shipment) or AS (shipping) status is a good sign, as long as that status is not over-aged. There are some differences, however, in the item manager's treatment of over-aged BA and AS documents. The remainder of Figure 2 portrays the BA status situation. Figure 3 will deal with the steps taken and questions asked when the status is something other than BA or AS. Figure 4 concentrates on the AS status scenario.

There was some debate among the experts interviewed as to when a BA status requisition should be considered "too

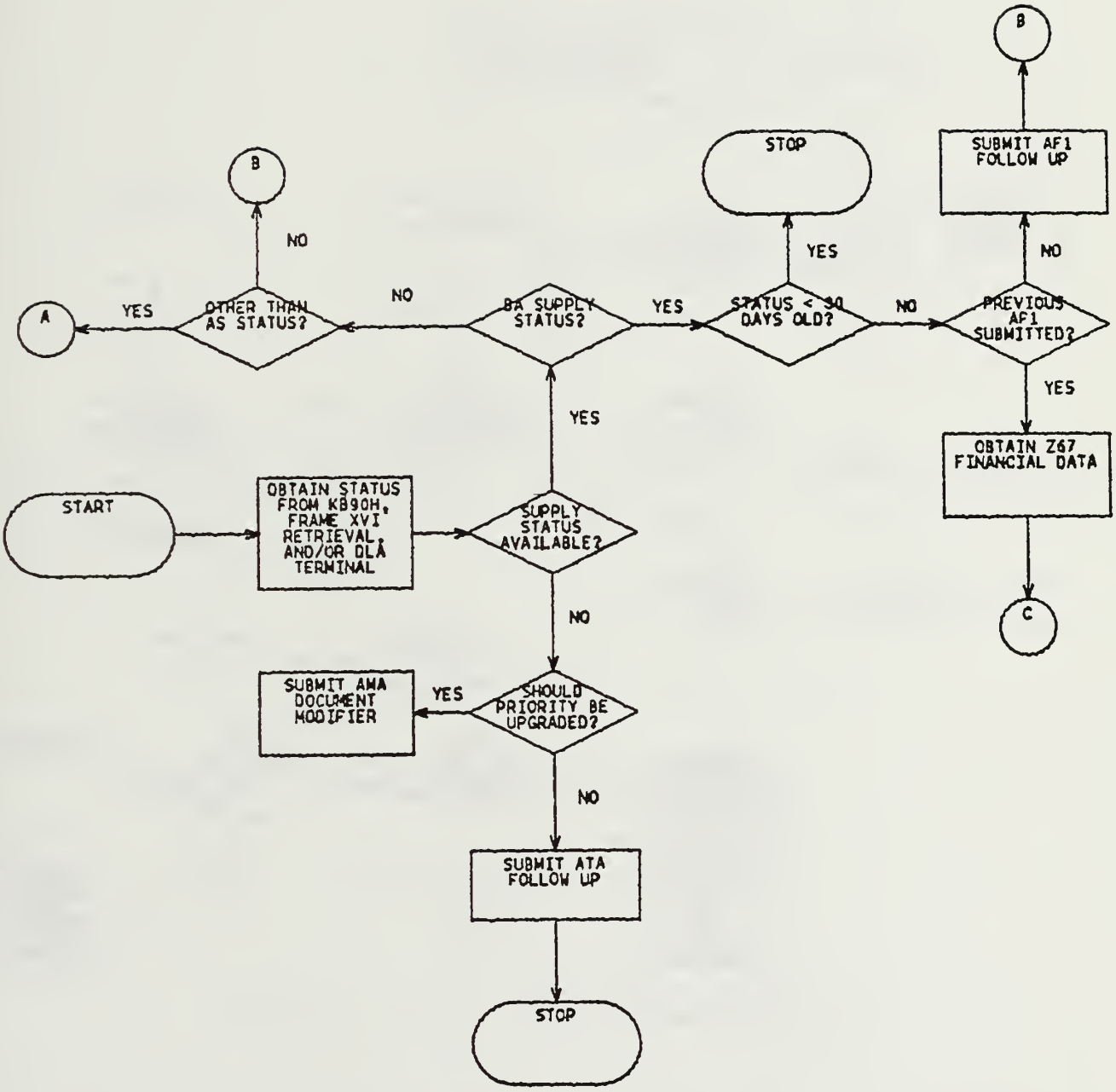

Figure 2 Delinquent Dues Processing (1)

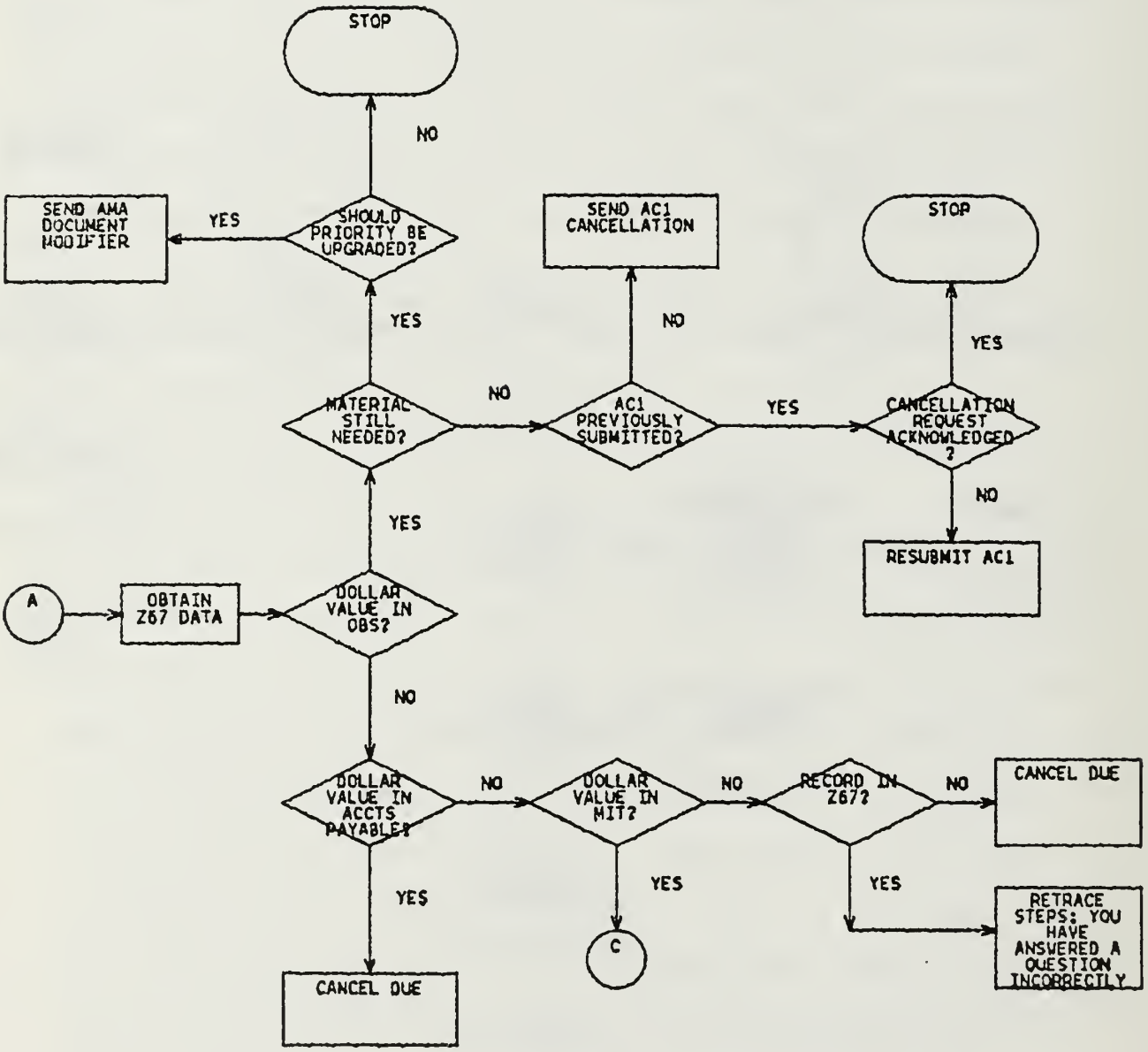

Figure 3 Delinquent Dues Processing (2)

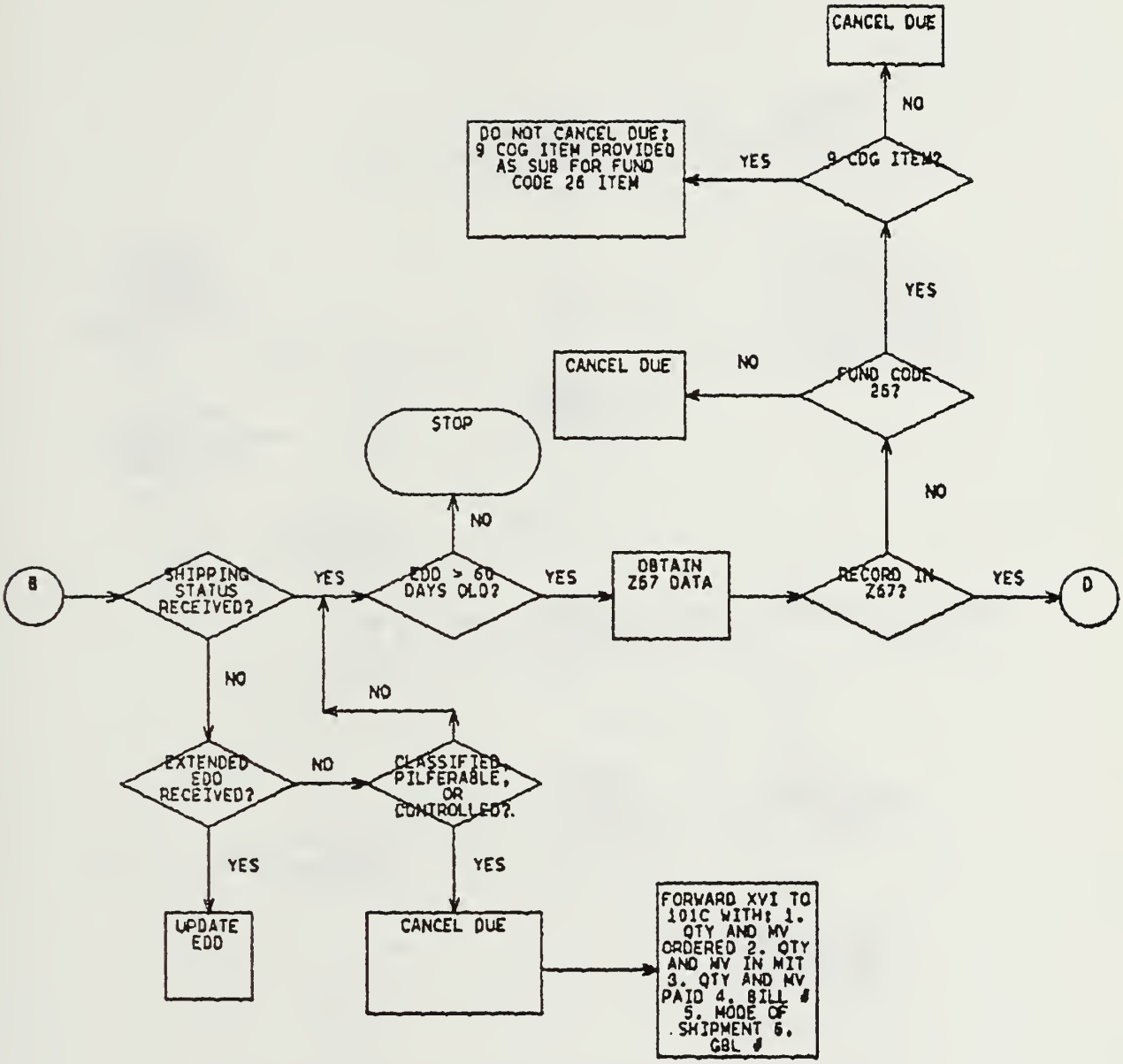

Figure 4 Delinquent Dues Processing (3)

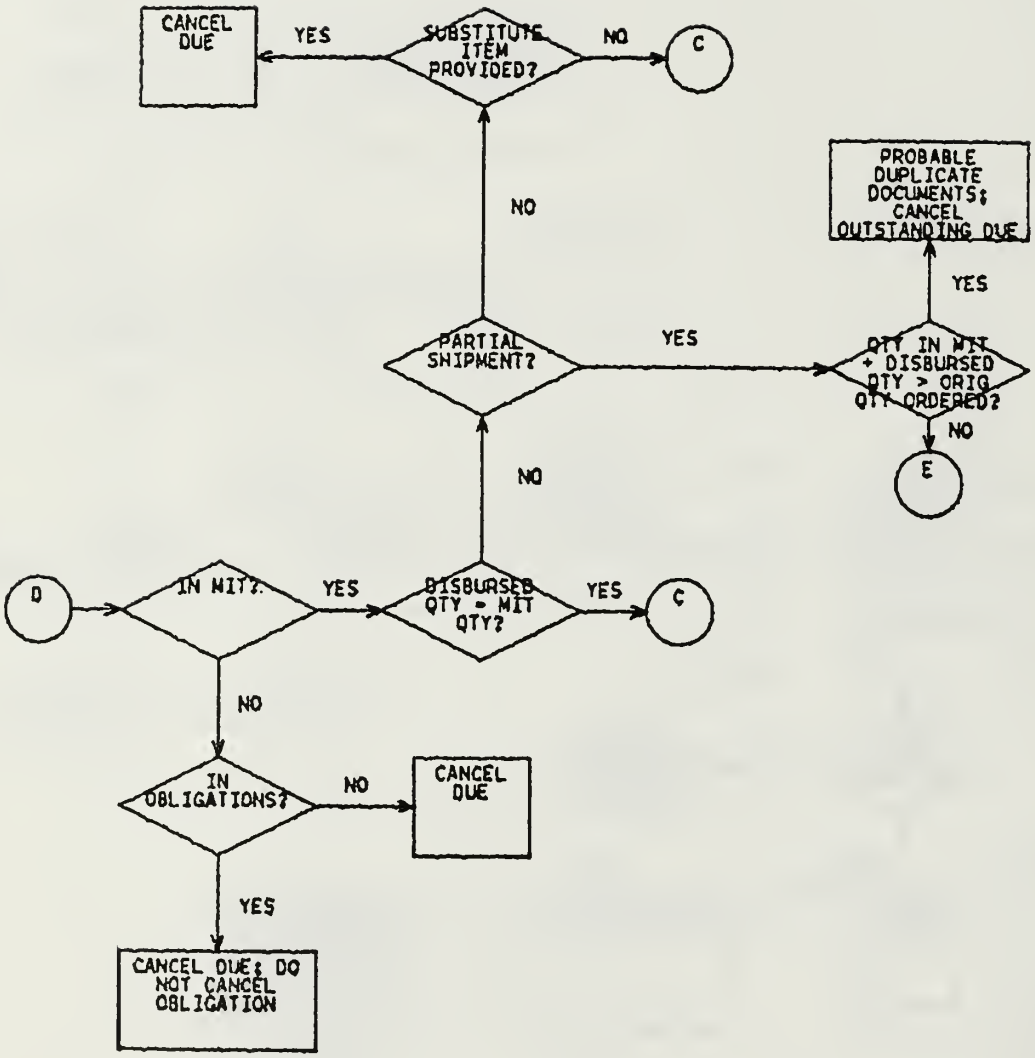

Figure 5 Delinquent Dues Processing (4)

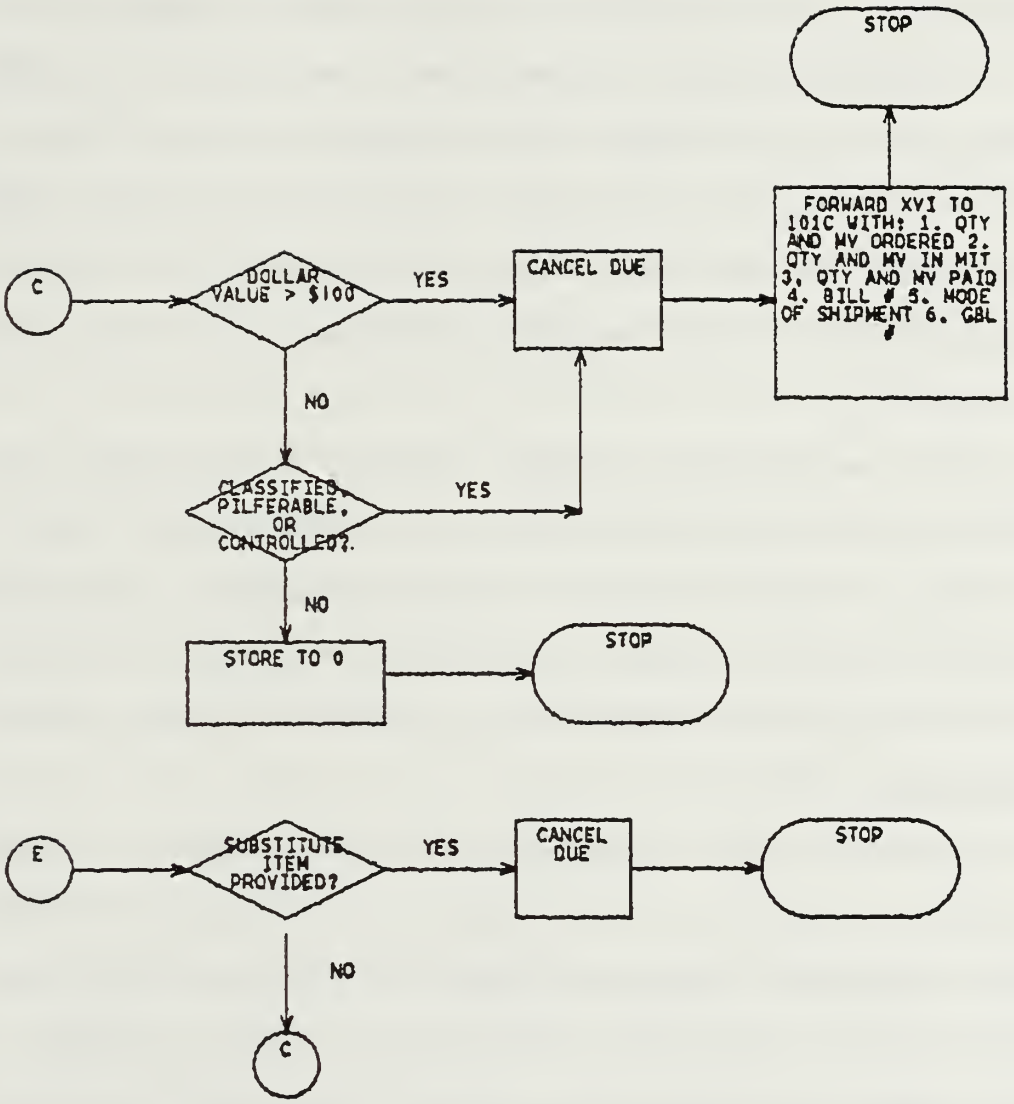

Figure 6 Delinquent Dues Processing (5)

old." Some argued for 45 days but eventually a consensus of opinion settled on 30 days. As seen in Figure 2, once the item manager determines that the requisition is overaged, he submits an AF1 document (a simple follow up request), as long as this action has not previously been taken.

If a follow up has already been forwarded to no effect, however, the item manager then considers the due to be invalid. At this point he needs financial data on the requisition prior to his final resolution of this particular delinquent due. A Z67 retrieval provides this financial information.

What does the item manager look for? The status of funds in the accounting ledgers provides valuable clues to the expert. The Obligations, Accounts Payable, and Material in Transit (MIT) Accounts are mutually exclusive fund categories. Each has a meaning for the item manager reviewing a delinquent due.

Armed with this financial data he proceeds to a final resolution on the due (see Figure 6 with reference to C). A $100 threshold determines whether the stock point finds it worthwhile to process a Report of Discrepancy (ROD). The ROD is sent to the shipping activity to request financial credit for non-received material. ROD research and preparation is performed by another code at the stock point. The item manager has discharged his responsibilities by forwarding the pertinent data to the ROD organization. This data

consists of the quantity and money value (the unit price multiplied by the quantity) ordered, the quantity and money value (if any) in the MIT Account, and the quantity and money value actually paid or disbursed. Additionally, the item manager provides the bill number, mode of shipment for the requisition, and its government bill of lading.

If the item is classified, pilferable, or controlled, a ROD is prepared, regardless of dollar value. Further research is always called for when sensitive material is missing. With noncontrolled material valued less than $100, the item manager's final action is to "store to zero," i.e., the requisition is cleared from the financial files by recording its receipt with a zero quantity. This has the effect of also automatically cancelling the due. For the potential ROD items, on the other hand, the item manager simply cancels the due but does not close the books by storing to zero. High dollar value or controlled items are stored to zero by the ROD section only after additional research.

Figure 3 covers the decision process when the status received is other than BA or AS (shipping) status. Again, a Z67 retrieval is obtained. The status of funds is the key factor here. If the money value is still in the Obligations Account, it means that material has neither been received nor billed. He still has an opportunity to review the document for possible cancellation or upgrading in

priority. If cancellation is the preferred choice of action, he submits ACl cancellation requests until an acknowledgement is received. Acknowledgement does not necessarily mean that the cancellation request was confirmed with a BQ (cancelled) status from the providing activity. The item manager may receive status indicating that cancellation was not accomplished (B8 status), or that it may not be possible (B9 status). Still, at this point a response has been received to the original ACl, and, if his cancellation attempt has been unsuccessful, he has no other recourse and cannot prevent the receipt of material he no longer needs.

If funds are lodged in Accounts Payable, it means that material has been received, but a bill for that material has not. Obviously the due can be cancelled at this point.

The usual tip-off of a possible invalid due is when funds are still shown as being in the Material in Transit (MIT) account. If funds are in MIT it means that a bill has been received and paid without a matching receipt of stock. The most likely conclusion to be drawn from the MIT funds status is that the actual shipment of stock will never be received. The next steps for terminating the due are the same as those discussed previously (see Figure 6 with reference to C). However, if a review of the financial files turns up no trace of the document, cancellation of the due is appropriate without any further review.

Figure 4 portrays the next stage of the review. A follow up response (see Figure 2 with reference to B) may inform the item manager of a revised or extended EDD, which makes the requisition no longer delinquent. If recent shipping status is received in response to a follow up, the item manager stops at that point, considering it prudent to wait a while longer to see if the document will eventually clear through a material receipt. If no revision to the EDD is received, and the item is classified, pilferable or controlled, a ROD is always called for, so the item manager gathers the appropriate information as covered in the previous discussion of Figure 6.

Figure 4 also lists the questions posed by the item manager when the shipping status has an EDD greater than 60 days old. Although finding no entry in the Z67 records would normally justify a cancellation of the due, several questions are possible. A Fund Code 26 entry on the Delinquent Dues Listing (appearing in column FC of Figure 1) indicates the due is "pushed" material funded by a Navy ICP rather than stock point dollars. If the due being received is a 9 cog item (i.e., managed by a DLA ICP), it is being provided as a substitute for an original Fund Code 26 item, and the inventory manager should definitely not cancel the due.

Figure 5 starts with the premise that Z67 data is available (see Figure 4 with reference to D), but adds several

other complications to muddy the waters. The manager must consider the possibility that a bill for this requisition with overaged status may yet show up. Accordingly, if the funds are still in the Obligations Account, the item manager cancels the due but leaves the obligation on the books for subsequent financial reconciliation by other codes in the stock point. The reason is that he is certain he can cancel the due, but he cannot be sure that a bill will not arrive at a later time, pushing the document into the MIT Account. Funds must remain obligated until the possibility of a bill has been eliminated.

More complications arise if partial and/or substitute shipments have been provided in lieu of a one time shipment of the original NSN. Partial shipments (indicated by a suffix code at the end of the document number) often leave the Navy stock point with more (if the same document is inadvertently passed to two different activities) or less than what was originally ordered--rarely does the sum total of partial shipments equal the quantity requisitioned. The item manager must be sensitive to the reality that partial shipments that remain outstanding are highly suspect and often duplicates.

Figure 6 (with reference to E) ties up the remaining loose ends of Delinquent Dues processing. The item manager has left Figure 5 at E knowing that there was a partial shipment. He has concluded that there were no duplicate

documents, however, because of several facts. He knows that the disbursed quantity is that quantity of the NSN paid for, regardless of whether it was received or not. The MIT quantity, once again, represents the quantity paid for and not received. Therefore, the difference between the MIT and disbursed quantities is the physical quantity that was received. Accordingly, since the quantities paid for (but not received) in MIT plus the extra quantities disbursed (and received) do not exceed the original quantity ordered, the item manager concludes that he is not dealing with a duplicate document situation. But the failure of the MIT and disbursed quantities to match may be attributable to something else--the shipment of a substitute item in one of the partial shipments. If a substitute was provided, the due can be cancelled, since the requirement was filled with an alternate stock number. If there was no substitute, the item manager enters into the termination phase of his review (see Figure 6 with reference to C).

D. DELINQUENT DUES DECISION RULES

An expert system will typically arrive at a recommendation by examining all appropriate decision rules, or conditional statements, and matching them with the data provided and the situation encountered. Conditional "if . . . then . . ." statements have the virtue of allowing the user to retrace the line of reasoning followed by the system in recommending a course of action. [Ref. 2]

The order of presentation for the decision rules is generally from the complex, multiple condition situations to the simpler scenarios having fewer conditions. An exception to this general rule occurs when one (or relatively few) conditions eliminate an entire category or class of situations from further review. The purpose of this sequence of decision rules, which is common in expert system development, is to ensure that possible conclusions or inferences are not prematurely eliminated from consideration because of a system recommendation based on a preceding simple condition. The more conditions or "if" statements present, the less ambiguity there normally is about the specific conclusion to draw from the data. Decision rules that move from complexity to simplicity allow the system to consider all possibilities before recommending a course of action. [Ref. 4] The following decision rules can serve as the foundation for an expert system capable of Delinquent Dues processing:

Rule 1

If:

1. No supply status has been received, and
2. The priority of the requisition should be upgraded,

Then:

Submit an AMA modifier which will follow up or reestablish the document and raise the priority.

Rule 2

If:

1. No supply status has been received, and
2. The current priority is satisfactory,

Then:

Submit an ATA follow up.

Rule 3

If:

1. The status is other than BA or AS, and
2. The funds are in Accounts Payable,

Then:

The due should be cancelled.

Rule 4

If:

1. The status is other than BA or AS, and
2. There is no Z67 record,

Then:

Cancel the due.

Rule 5

If:

1. The status is BA, and
2. The status is greater than 30 days old, and
3. Neither AS status nor a revised EDD has been received in response to a follow up, and
4. The item is not classified, pilferable, or controlled, and
5. The EDD is not greater than 60 days old,

Then:

No action is required as of yet.

Rule 6

If:

1. The status is BA, and
2. The status is greater than 30 days old, and
3. Neither AS status nor a revised EDD has been received in response to a follow up, and
4. The item is classified, pilferable, or controlled,

Then:

Cancel the due and forward the appropriate ROD information.

Rule 7

If:

1. The status is BA, and
2. The status is greater than 30 days old, and
3. An extended EDD is received in response to a follow up,

Then:

Update the EDD in file. The document is no longer delinquent.

Rule 8

If:

1. BA supply status is received, and
2. The status is greater than 30 days old, and
3. A follow up was previously submitted, and
4. The dollar value is less than $100, and
5. The item is not classified, pilferable, or controlled,

Then:

Store to zero.

Rule 9

If:

1. BA supply status is received, and
2. The status is greater than 30 days old, and
3. A follow up was previously submitted, and
4. The dollar value is greater than $100, or the item is classified, pilferable, or controlled,

Then:

Cancel the due and forward the appropriate ROD information.

Rule 10

If:

1. BA supply status is received, and
2. The status is grater than 30 days old, and
3. No follow up has been submitted,

Then:

Confirmation of supply status is needed. Submit an AF1 follow up.

Rule 11

If:

1. BA supply status is received, and
2. The status is less than 30 days old, and

Then:

Evidence indicates good supply status. No further action is called for.

Rule 12

If:

1. The status is other than BA or AS, and
2. The funds are in MIT, and
3. The dollar value is less than $100, and
4. The item is not classified, pilferable, or controlled,

Then:

Store to zero.

Rule 13

If:

1. The status is other than BA or AS, and
2. The funds are in MIT, and
3. The dollar value is greater than $100 or the item is classified, pilferable, or controlled,

Then:

Cancel the due and forward the appropriate ROD information.

Rule 14

If:

1. The status is other than BA or AS, and
2. The funds are in Obligations, and
3. The material is no longer needed, and
4. A cancellation request has not been submitted,

Then:

Send an AC1 cancellation request.

Rule 15

If:

1. The status is other than BA or AS, and
2. The funds are in Obligations, and
3. The material is no longer needed, and
4. A cancellation request has not been acknowledged,

Then:

Submit another cancellation request.

Rule 16

If:

1. The status is other than BA or AS, and
2. The funds are in Obligations, and
3. The material is no longer needed, and
4. A cancellation request has been acknowledged,

Then:

No further action is required.

Rule 17

If:

1. The status is other than BA or AS, and
2. The funds are in Obligations, and
3. The material is still needed, and
4. The priority of the requisition should be upgraded,

Then:

Send an AMA modifier to raise the priority.

Rule 18

If:

1. The status is other than BA or AS, and
2. The funds are in Obligations, and
3. The material is still needed, and
4. The current priority is satisfactory,

Then:

No action is required.

Rule 19

If:

1. AS status is received, and
2. The EDD is not greater than 60 days old,

Then:

No further action is required as of yet.

Rule 20

If:

1. AS status is received, and
2. The EDD is greater than 60 days old, and
3. The funds are in MIT, and
4. The disbursed physical quantity is not equal to the MIT physical quantity, and
5. There is a partial shipment, and
6. The quantity in MIT plus the disbursed quantity is not greater than the original quantity ordered, and
7. A substitute was not provided, and
8. The dollar value is less than $100, and
9. The item is not classified, pilferable, or controlled,

Then:

Store to zero.

Rule 21

If:

1. As status is received, and
2. The EDD is greater than 60 days old, and
3. The funds are in MIT, and
4. The disbursed physical quantity is not equal to the MIT physical quantity, and
5. There is a partial shipment, and
6. The quantity in MIT plus the disbursed quantity is not greater than the original quantity ordered, and
7. A substitute was not provided, and
8. The dollar value is greater than $100 or the item is classified, pilferable, or controlled,

Then:

Cancel the due and forward the appropriate ROD information.

Rule 22

If:

1. AS status is received, and
2. The EDD is greater than 60 days old, and
3. The funds are in MIT, and
4. The disbursed physical quantity is not equal to the MIT physical quantity, and
5. There is a partial shipment, and
6. The quantity in MIT plus the disbursed quantity is not greater than the original quantity ordered, and
7. A substitute was provided,

Then:

Cancel the due.

Rule 23

If:

1. AS status is received, and
2. The EDD is greater than 60 days old, and
3. The funds are in MIT, and
4. The disbursed physical quantity is not equal to the MIT physical quantity, and
5. There is a partial shipment, and
6. The quantity in MIT plus the disbursed quantity is greater than the original quantity ordered,

Then:

Cancel the outstanding due. Probable explanation is duplicate documents for some of the outstanding shipments.

Rule 24

If:

1. AS status is received, and
2. The EDD is greater than 60 days old, and
3. The funds are in MIT, and
4. The disbursed physical quantity is not equal to the MIT physical quantity, and
5. There is no partial shipment, and
6. No substitute is provided, and
7. The dollar value is less than $100, and
8. The item is not classified, pilferable, or controlled,

Then:

Store to zero.

Rule 25

If:

1. AS status is received, and
2. The EDD is greater than 60 days old, and
3. The funds are in MIT, and
4. The disbursed physical quantity is not equal to the MIT physical quantity, and
5. There is no partial shipment, and
6. No substitute is provided, and
7. The dollar value is greater than $100 or the item is classified, pilferable, or controlled,

Then:

Cancel the due and forward the appropriate ROD information.

Rule 26

If:

1. AS status is received, and
2. The EDD is greater than 60 days old, and
3. The funds are in MIT, and
4. The disbursed physical quantity is equal to the MIT physical quantity, and
5. The dollar value is less than $100, and
6. The item is not classified, pilferable, or controlled,

Then:

Store to zero.

Rule 27

If:

1. AS status is received, and

2. The EDD is greater than 60 days old, and

3. The funds are in MIT, and

4. The disbursed physical quantity is not equal to the MIT physical quantity, and

5. There is no partial shipment, and

6. There is a substitute provided,

Then:

Cancel the due.

Rule 28

If:

1. AS status is received, and

2. The EDD is greater than 60 days old, and

3. The funds are in MIT, and

4. The disbursed physical quantity is equal to the MIT physical quantity, and

5. The dollar value is greater than $100 or the item is classified, pilferable, or controlled,

Then:

Cancel the due and forward the appropriate ROD information.

Rule 29

If:

1. AS status is received, and

2. The EDD is greater than 60 days old, and

3. There is a Z67 record, and

4. The funds are in neither MIT nor Obligations,

Then:

Cancel the due.

Rule 30

If:

1. AS status is received, and
2. The EDD is greater than 60 days old, and
3. The funds are in Obligations,

Then:

Cancel the due. Take no action to cancel the outstanding obligation.

Rule 31

If:

1. AS status is received, and
2. The EDD is greater than 60 days old, and
3. There is no Z67 record, and
4. The document is a Fund Code 26 item, and
5. The NSN due is a 9 cog item,

Then:

Do not cancel the due. The 9 cog item is probably being shipped as a substitute for a Fund Code 26 item.

Rule 32

If:

1. AS status is received, and
2. The EDD is greater than 60 days old, and
3. There is no Z67 record, and
4. The document is a Fund Code 26 item, and
5. The NSN due is not a 9 cog item,

Then:

Cancel the due.

Rule 33

If:

1. AS status is received, and
2. The EDD is greater than 60 days old, and
3. There is no Z67 record, and
4. The document is not a Fund Code 26 item,

Then:

Cancel the due.

III. VARIABLE RANKING LISTS

A. INTRODUCTION

Variable Ranking Lists, quarterly hard copy outputs of UADPS-SP programs H-UA64 and H-UA65, provide a mechanized screening and highlighting of situations requiring item manager review. There are seven basic problem areas, denoted as "groups," which may be accessed through Variable Ranking, as follows:

GROUP	DEFINITION
1	Excess on Order
2	Backorder with Material On Hand
3	Backorder with 0 On Hand, 0 Due
4	Invalid on Order
5	0 Assets
6	Insufficient Stock
7	Excess On Hand

Only Groups 1, 3, and 5 are worked by NSC inventory managers, because other programs and reviews provide adequate coverage of the other situations.

This chapter will present a detailed narrative describing the expert item manager's processing of Groups 1, 3, and 5 of the Variable Ranking Lists. Flowcharts are included to aid reader understanding. Finally, the expert item manager's methodology is distilled into decision rules in the form of "if . . . then . . ." statements for each of the three groups.

B. PROCESSING GROUP 1--EXCESS ON ORDER

The Group 1 Listing (see Figure 7) is in National Stock Number (NSN) sequence, and contains the cog (AC), acquisition

U465 VAR-RANK-PRDG - - - GROUP DECISION 1 ON-ORDER REPORT - - - •NSC SAN DIEGO, CALIFORNIA • DATE 01-12-85 PAGE 98

AC M P	N-S-N	$ EXCESS	AC M P	N-S-N	$ EXCESS	AC M P	N-S-N	$ EXCESS
9G D A	4920001667708	2,239.54	9G D A	4920001584799	1,859.70	9G D A	4920001685147	585.59
9G D A	4920001685242	1,309.98	9G D A	4920001695521	3,477.01	9G D A	4920001695748	5,323.99
9G D A	4920001725415	2.70	9G D A	4920003995379	612.32	9G D A	4920009413096	261.82
9G D A	4920009413099	459.89	9G D A	4920009869081	285.66	9G D A	4920010103824	1,048.50
9G D A	4920010258698	5,225.07	9G D A	5940000275557	197.16	9G D A	5940000802158	.24
9G D A	5940000824885	5.64	9G D A	5940001102799	243.44	9G D A	5940001133137	30.84
9G D A	5940001139825	.16	9G D A	5940001395228	330.40	9G D A	5940001462844	.26
9G D A	5940001979756	4.74	9G D A	5940002256801	3.48	9G D A	5940002571263	2.10
9G D A	5940002582120	3.33	9G D A	5940002585897	28.12	9G D A	5940002585902	990.09
9G D A	5940002775185	26.51	9G D A	5940003365889	464.01	9G D A	5940003512223	982.45
9G D A	5940005496220	3.84	9G D A	5940005522024	19.92	9G D A	5940005556277	311.22
9G D A	5940006659588	770.10	9G D A	5940007068090	3.15	9G D A	5940007859383	1.04
9G D A	5940008087220	3.78	9G D A	5940008094358	6.40	9G D A	5940009149919	152.64
9G D A	5940009260011	3.96	9G D A	5940009260042	.12	9G D A	5940009358222	5.32
9G D A	5940009836046	54.94	9G D A	5940009880317	9.90	9G D A	5940010827542	2.40
9G D A	5940011212147	878.68	9G D A	5940011354520	784.22	9G D A	5940011357087	49.28
9G D A	5940011362540	854.42	9G D A	5970000038557	3.45	9G D A	5970000041040	10.01
9G D A	5970000163377	79.74	9G D A	5970000413576	54.72	9G D A	5970000432922	45.09
9G D A	5970000524877	5.55	9G D A	5970000597334	9.36	9G D A	5970000880790	16.20
9G D A	5970001108234	25.24	9G D A	5970001175189	48.60	9G D A	5970001483638	2.52
9G D A	5970001502009	15.12	9G D A	5970001810190	29.25	9G D A	5970001866627	128.18
9G D A	5970001992999	989.36	9G D A	5970002215282	46.92	9G D A	5970002215343	1.94
9G D A	5970002310244	3.36	9G D A	5970002503029	.16	9G D A	5970004481736	.56
9G D A	5970004898844	.36	9G D A	5970005297129	3.43	9G D A	5970005562832	1.30
9G D A	5970006175798	.80	9G D A	5970008175375	4.15	9G D A	5970006829531	.82
9G D A	5970006834140	69.35	9G D A	5970005962751	4.80	9G D A	5970007028410	1.14

Figure 7 Sample Group 1 Listing

advice code(M), purpose code(P), and total excess dollar value. These items are potentially in long supply (i.e., a situation in which there is too much stock on hand and on order considering the item's demand history and budgetary constraints). Cancelling requisitions for NSNs in long supply frees up funds which can be used to purchase other items that are experiencing deficiencies.

Figures 8, 9, and 10 portray the expert's Group 1 decision making. Referring to Figure 8, the first rule in Group 1 processing is to eliminate those items whose excess on order dollar value is less than $500. These dollar values are not large enough to merit further investigation. Next, the item manager obtains a scan of the Master Stock Item Record (MSIR) and of the Due File by submitting a ZDU inquiry. This provides the vital statistics for this particular NSN, including price, unit of issue, demand history, outstanding dues, recent receipts, and backorders. He then converts his excess dollar value to an excess physical quantity by using the following formula: the excess quantity is the difference between the on hand plus due in stock minus that needed for the item's requisitioning objective (RO), its Prepositioned War Reserve Stock (PWRS) (if any), its backorders (BO) (if any), its Numeric Stockage Objective (NSO) (a quantity of the item that is carried because of its essentiality even though not justified by demand), and any

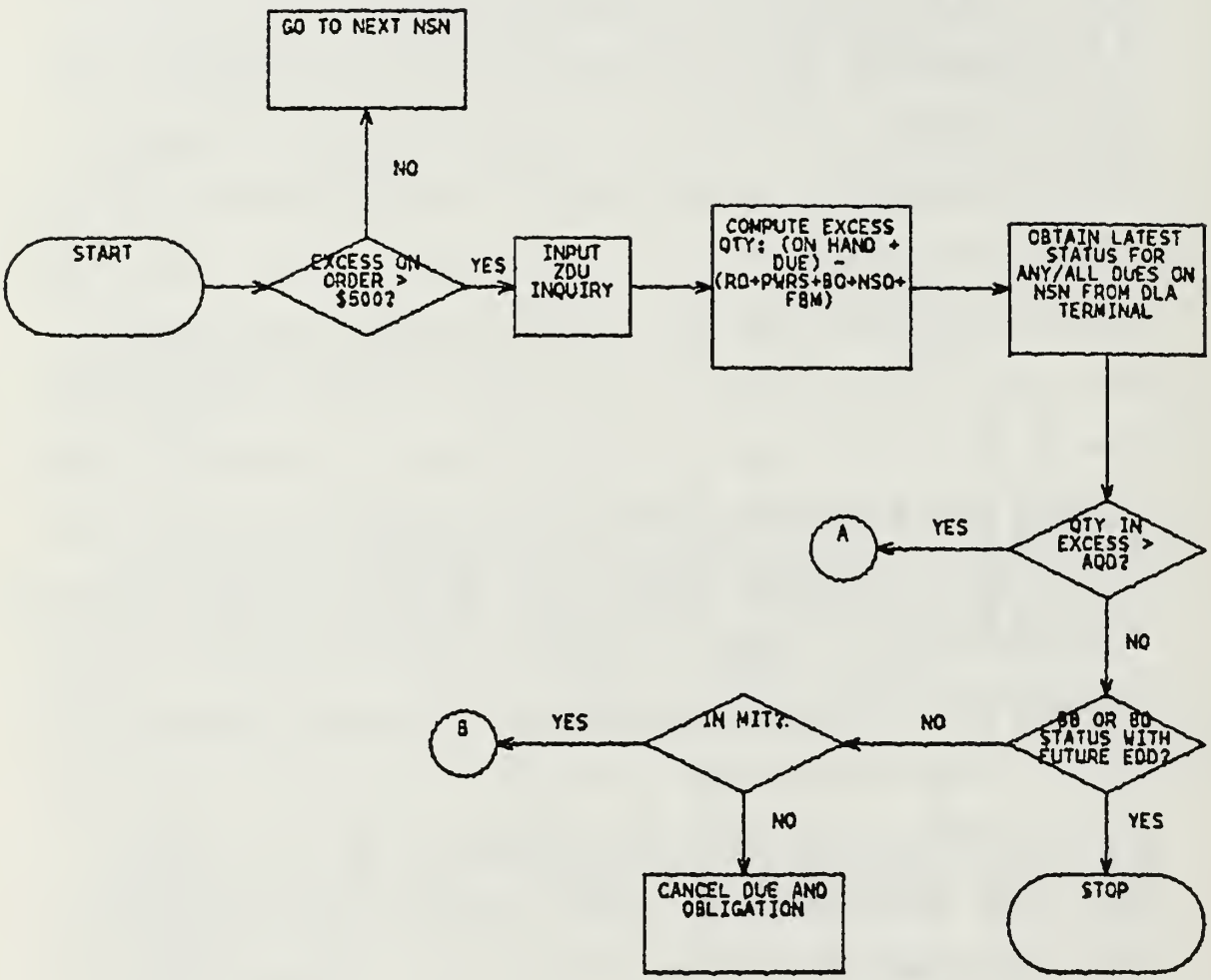

Figure 8 Group 1 Processing (1)

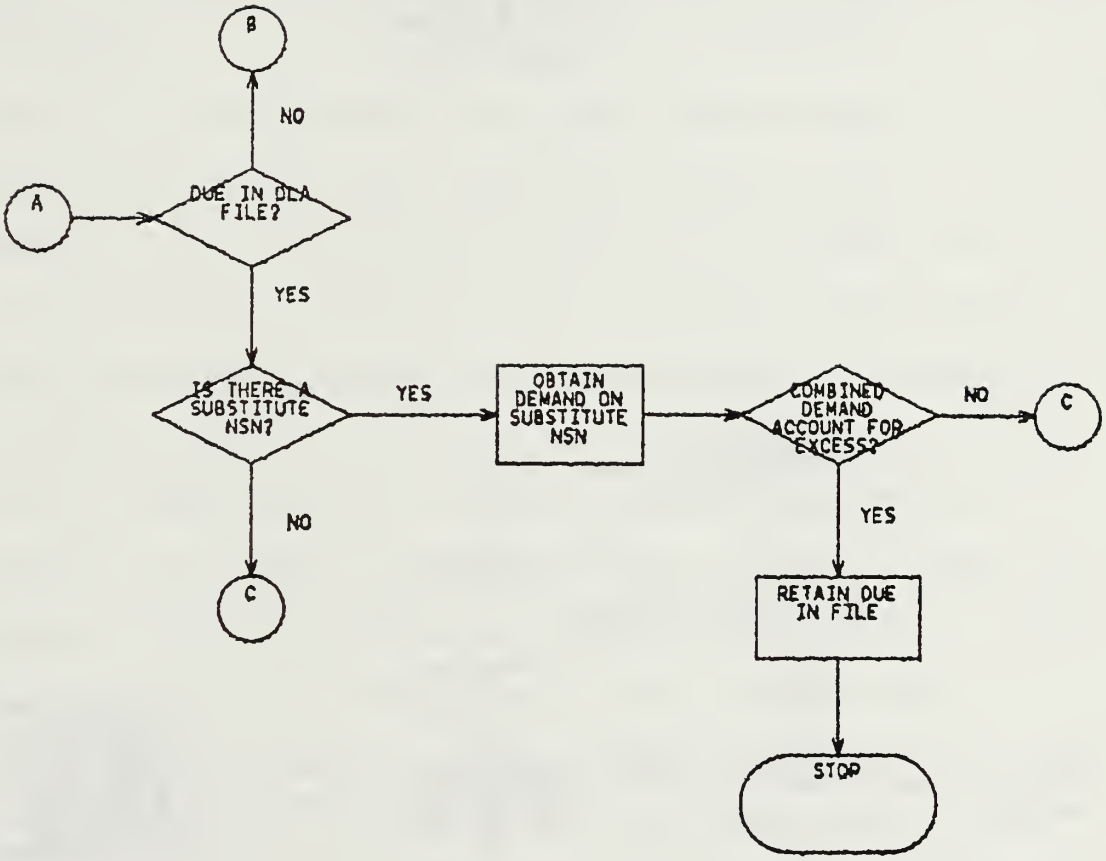

Figure 9 Group 1 Processing (2)

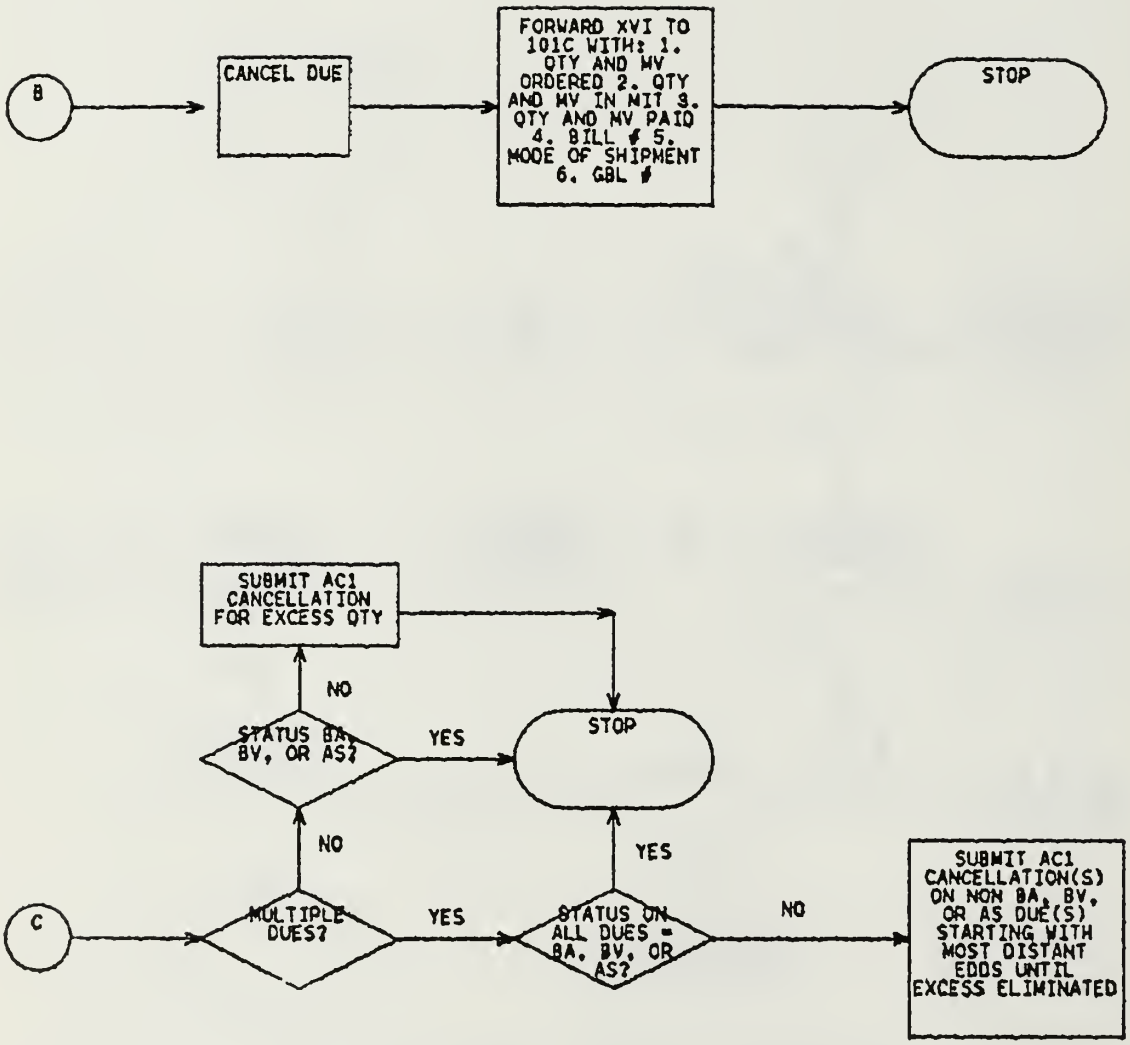

Figure 10 Group 1 Processing (3)

Fleet Ballistic Missile (FBM) protection level (an additional layer of reserve stock which normally can be accessed only by FBM submarines).

Once the excess quantity on order is determined, the item manager compares that with the NSN's Average Quarterly Demand (AQD). If the excess is relatively small (e.g., less than what would be attrited through normal demand in the course of one quarter), it is not worth the processing costs or the item manager's time to attempt a cancellation. As long as the requisition has a good current status (e.g., BB or BD with a future EDD), the item manager takes no further action. But if the status is aged (e.g., an EDD more than 60 days old), he simply cancels the due and forwards the appropriate ROD information for the purpose of requesting financial credit for the non-received material (see Figure 10 with reference to B). Fewer steps are required here to determine if a ROD is appropriate than in the standard Delinquent Dues review displayed above in Figure 6. The prerequisite for the excess money value to exceed $500 eliminates any need to ask money value questions for inexpensive items, or to determine if the NSN is controlled, since ROD preparation and cancellation of the due are the recommended actions for all high dollar value items.

Figure 9 portrays the questions the expert asks when the excess quantity exceeds the AQD. Once again, if no record of the due's current status exists, the modified

Delinquent Dues sequence is reprised (see the top half of Figure 10). When good status is available, the expert must ask several additional questions before cancelling the excess quantity. If there is some form of interchangeability with another NSN indicated in the MSIR, it may be useful to retain the due in file even though it results in an excess quantity on the original NSN. This would be appropriate when the combined demand for the original and substitute NSNs obviates the excess.

The bottom of Figure 10 displays the expert's method for deciding which, if any, dues can be cancelled. He knows that a requisition with BA, AS, or BV (item procured and on contract for direct shipment to consignee) status cannot be cancelled because they are either already shipped, very close to shipment, or under contract with a vendor for direct shipment. If all of the due or dues (multiple dues for the same NSN are possible) have one of these status codes, there is no further action he can take and he must live with the excess. If he has other status codes to choose from, however, the item manager will request cancellation on any or all dues, starting with those with the most distant EDDs, until the excess is eliminated.

C. GROUP 1 DECISION RULES

An expert system will typically arrive at a recommendation by examining all appropriate decision rules, or conditional statements, and matching them with the data provided

and the situation encountered. Conditional "if . . . then . . ." statements have the virtue of allowing the user to retrace the line of reasoning followed by the system in recommending a course of action [Ref. 2]. The following decision rules are the essence of the expert's methods as described in the Group 1 narrative. These decision rules can serve as the foundation for an expert system capable of Group 1 processing.

Rule 1

If:

1. The excess on order EMV is not greater than $500,

Then:

No action is required.

Rule 2

If:

1. The excess on order EMV is greater than $500, and
2. The quantity in excess is not greater than AQD, and
3. The document has BB or BD status with a future EDD,

Then:

No action is required.

Rule 3

If:

1. The excess on order EMV is greater than $500, and
2. The quantity in excess is greater than AQD, and
3. Current status for the due is in file, and
4. There is no substitute NSN, and

5. There are multiple dues, and

6. At least one of the dues has a status other than BA, BV, or AS,

Then:

Cancel any or all dues with other than BA, BV, or AS status, starting with those having the most distant EDDs, until the excess is eliminated, or there are no more dues.

Rule 4

If:

1. The excess on order EMV is greater than $500, and

2. The quantity in excess is greater than AQD, and

3. Current status for the due is in file, and

4. There is no substitute NSN, and

5. There are multiple dues, and

6. All dues have a status of either BA, BV, or AS,

Then:

None of the dues can be cancelled. No action is recommended.

Rule 5

If:

1. The excess on order EMV is greater than $500, and

2. The quantity in excess is greater than AQD, and

3. Current status for the due is in file, and

4. There is no substitute NSN, and

5. There are no multiple dues, and

6. The status is other than BA, BV, or AS,

Then:

The excess quantity should be cancelled.

Rule 6

If:

1. The excess on order EMV is greater than $500, and
2. The quantity in excess is greater than AQD, and
3. Current status for the due is in file, and
4. There is no substitute NSN, and
5. There are no multiple dues, and
6. The status on the due is BA, BV, or AS,

Then:

The due cannot be cancelled. No action is recommended.

Rule 7

If:

1. The excess on order EMV is greater than $500, and
2. The quantity in excess is greater than AQD, and
3. Current status for the due is in file, and
4. There is a substitute NSN, and
5. The combined demand for the original and substitute NSNs does not account for the excess, and
6. There are multiple dues, and
7. At least one of the dues has a status other than BA, BV, or AS,

Then:

Cancel any or all dues with other than BA, BV, or AS status, starting with those having the most distant EDDs, until the excess is eliminated or there are no more dues.

Rule 8

If:

1. The excess on order EMV is greater than $500, and

2. The quantity in excess is greater than AQD, and

3. Current status for the due is in file, and

4. There is a substitute NSN, and

5. The combined demand for the original and substitute NSNs does not account for the excess, and

6. There are no multiple dues, and

7. The status is other than BA, BV, or AS,

Then:

The excess quantity should be cancelled.

Rule 9

If:

1. The excess on order EMV is greater than $500, and

2. The quantity in excess is greater than AQD, and

3. Current status for the due is in file, and

4. There is a substitute NSN, and

5. The combined demand for the original and substitute NSNs does not account for the excess, and

6. There are multiple dues, and

7. All dues have a status of either BA, BV, or AS,

Then:

None of the dues can be cancelled. No action is recommended.

Rule 10

If:

1. The excess on order EMV is greater than $500, and

2. The quantity in excess is greater than AQD, and

3. Current status for the due is in file, and

4. There is a substitute NSN, and

5. The combined demand for the original and substitute NSNs does not account for the excess, and

6. There are no multiple dues, and

7. The status on the due is BA, BV, or AS,

Then:

The due cannot be cancelled. No action is recommended.

Rule 11

If:

1. The excess on order EMV is greater than $500, and

2. The quantity in excess is greater than AQD, and

3. Current status for the due is in file, and

4. There is a substitute NSN, and

5. The combined demand for the original and substitute NSNs accounts for the excess,

Then:

The due should be retained in file. No action is recommended.

Rule 12

If:

1. The excess on order EMV is greater than $500, and

2. The quantity in excess is greater than AQD, and

3. Current status for the due is not in file,

Then:

Cancel the due and forward the appropriate ROD information.

Rule 13

If:

1. The excess on order EMV is greater than $500, and

2. The quantity in excess is not greater than AQD, and

3. Neither BB nor BD status with a future EDD is available, and

4. The funds are in MIT,

Then:

Cancel the due and forward the appropriate ROD information.

Rule 14

If:

1. The excess on order EMV is greater than $500, and

2. The quantity in excess is not greater than AQD, and

3. Neither BB nor BD status with a future EDD is available, and

4. The funds are not in MIT,

Then:

Cancel the due and obligation.

D. PROCESSING GROUP 3--BACKORDER WITH 0 ON HAND, 0 DUE

The Group 3 Listing (see Figure 11), normally very small, highlights those NSNs having one or more customer requisitions backordered but which have neither stock on hand nor due in. An XVC retrieval from the In Process/Backorder File lists all the backorders for the NSN and alerts the item manager to the extent of the possible damage to his overall material availability statistics caused by this particular NSN. As Figure 12 indicates, if no backorders are found, no further review is required. The item manager concludes

UA65 VAR-RANK-PROG ITEMS RANKED BY--VALUE OF BACK ORDER STOCK •NSC SAN DIEGO, CALIFORNIA • GROUP 3 DATE 01-14-86 PAGE 1

ACM	PF	N-S-N	UI	SN	IR	$ VAD	$ ON-HAND	$ ON-ORDER	$ BK-ORDER	FAD	L/T	UNIT-PRICE	$ NSO	$ RO	$ RES	Y
9GL	A	9330003245620	SH		-	522.88	.00	275.20	309.60	006	2.2	8.60	.00	404.20	.00	G
9QD	A	6840011800167	BX			433.19	.00	.00	62.24	013	2.6	15.56	.00	482.36	.00	G

TOTAL $ VAD	TOTAL $ ON-HAND	TOTAL $ ON-ORDER	TOTAL $ BK-ORDER	TOTAL $ NSO	TOTAL $ RO	TOTAL $ RES
956.07	.00	275.20	371.84	.00	886.56	.00

Figure 11 Sample Group 3 Listing

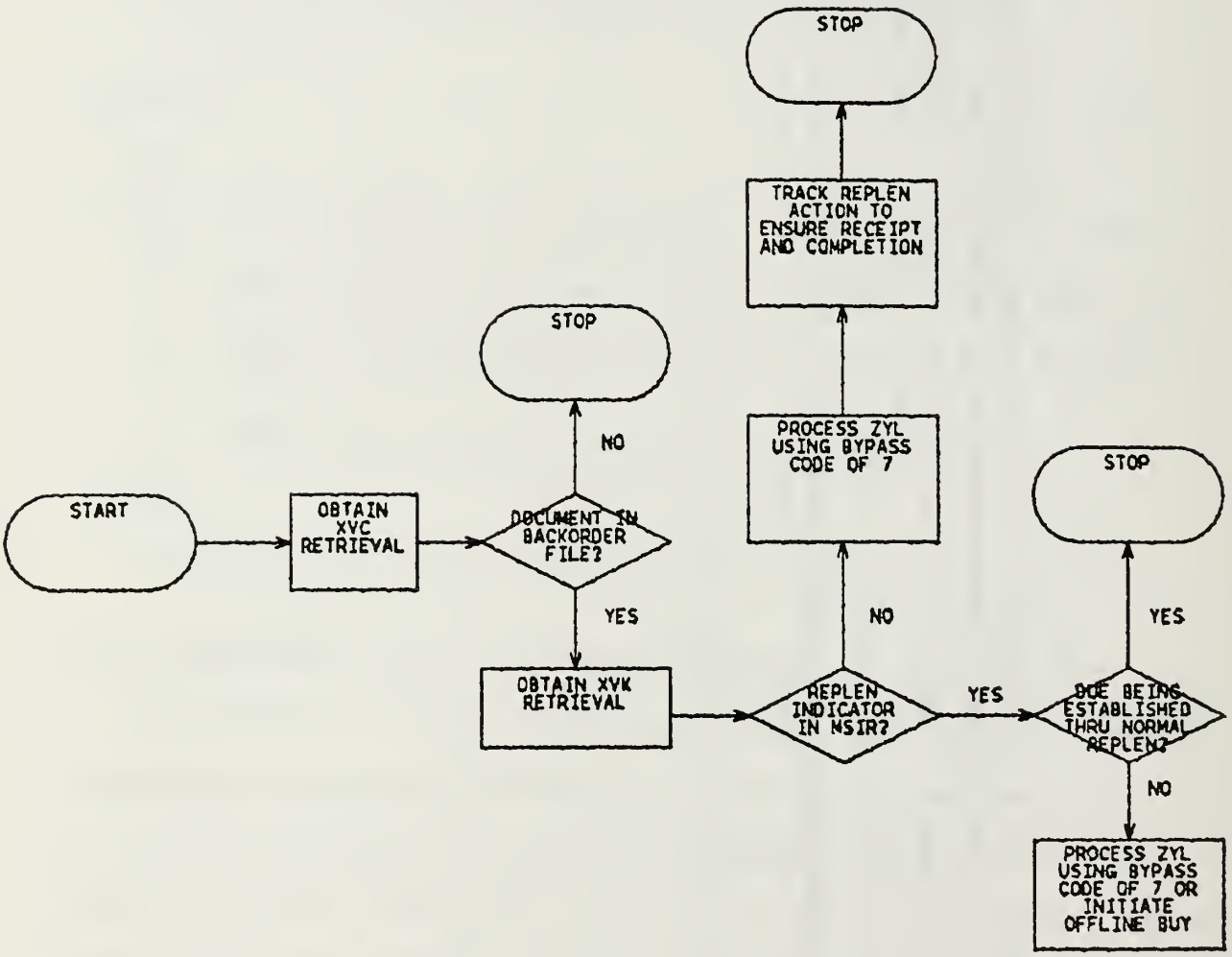

Figure 12 Group 3 Processing

that a file update since the last running of the Group 3 Listing apparently cleared the backorders.

On the other hand, if backorders are still lodged against the NSN, a MSIR inquiry (an XVK) is the expert's next step. He wants to know if there is a replenishment indicator in the MSIR. If none is found, it indicates that, for one reason or another, the program parameters that would normally trigger a replenishment action are not set. A ZYL document identifier is an interim replenishment notification, a signal that the reorder point for the NSN has been reached. Normally such a signal is processed through a replenishment program to verify the need for replenishment and to compute order quantities. A 7 bypass code forces the program to generate a buy by bypassing the verification replenishment program. The item manager may, however, choose to initiate an offline buy instead of a ZYL action. In a time sensitive situation, ZYL interim replenishments, which are run twice weekly, may not be responsive enough. An offline buy, while necessitating more manual processing, will start a critical buy immediately.

E. GROUP 3 DECISION RULES

The following decision rules are the essence of the expert's methods as described above in the Group 3 narrative. These decision rules can serve as the foundation for an expert system capable of Group 3 processing.

Rule 1

If:

1. There are no backorders on the NSN,

Then:

No action is recommended.

Rule 2

If:

1. There are backorders in file, and
2. There is no replenishment indicator,

Then:

Process a ZYL using a 7 bypass code.

Rule 3

If:

1. There are backorders in file, and
2. There is a replenishment indicator, and
3. A due is being established,

Then:

No action is recommended.

Rule 4

If:

1. There are backorders in file, and
2. There is a replenishment indicator, and
3. No due is being established,

Then:

Process a ZYL using a 7 bypass code or start an offline buy if the procurement must be initiated immediately.

F. GROUP 5--ZERO ASSETS

All NSNs on this list (see Figure 13) have zero on hand and zero due. This situation may arise if demand for an NSN is being satisfied by a substitute item, and the decision has been made to procure only the substitute. The NSN may also be a relatively new addition to those items managed by the stock point, without any buy recorded in file as of yet. The list is in sequence by the frequency of annual demand. Obviously those NSNs with the greatest frequency should be processed first.

As displayed in Figure 14, the first step is to see if a replenishment indicator (a dash in column R in Figure 13) is present. If none is found, it indicates that the program parameters that would normally trigger a replenishment action are not set. On the other hand, if one is present, the item manager can simply allow the normal replenishment program to generate a buy, or, if necessary, he can force a buy with a ZYL action.

The process when there is no replenishment indicator is only slightly more complicated. The key decision parameter becomes whether or not the NSN has some sort of interchangeability or substitutability with another NSN. This relationship is indicated by an index code (column I in Figure 13). A "Y" index code tells the item manager that the NSN under review has been superseded by a replacement stock number, that its stock should be exhausted, and that it is not to

ACN	PF	N-S-N	UI	SN	IR	$ VAD	$ ON-HAND	$ ON-ORDER	$ BK-ORDER	FAD	L/T	UNIT-PRICE	$ NSO	$ RO	$ RES	Y
9GY	A	5995011658414	EA	N		3765.68	.00	.00	.00	006	0.0	470.71	.00	1412.13	.00	O
9GY	A	5940005008723	EA	V	-	56.32	.00	.00	.00	006	0.0	.16	.00	23.68	.00	O
9GY	A	5975001461797	EA	RV	-	1128.88	.00	.00	.00	006	0.0	141.11	.00	423.33	.00	O
9GV	A	6210008027120	EA			4447.80	.00	.00	.00	006	0.0	370.65	.00	1853.25	.00	O
9GV	A	6210000581539	EA	N		6408.96	.00	.00	.00	006	0.0	200.28	.00	2603.64	.00	O
9GY	A	6210007825606	EA	N		16.32	.00	.00	.00	006	0.0	1.02	.00	5.10	.00	O
9GD	A	6750011525974	RL		-	627.00	.00	.00	.00	008	2.9	2.85	.00	416.10	.00	G
9GV	A	5975001948876	EA		Y	251.34	.00	.00	.00	006	1.9	1.18	.00	315.06	.00	I
9GD	A	4140004707557	EA		-	408.48	.00	.00	.00	006	1.0	4.44	.00	315.24	.00	H
9GV	A	4130005950133	EA		Y	2385.68	.00	.00	.00	006	1.3	38.88	.00	2099.52	.00	D
9GD	A	9150002234007	CN		Y	81.22	.00	.00	.00	006	0.9	5.92	.00	53.28	.00	J
9GJ	A	8150008346804	EA		P	97.42	.00	.00	.00	006	1.1	1.72	.00	137.60	.00	J
9GD	A	9340009624372	EA		W	93.18	.00	.00	.00	006	0.1	12.66	.00	88.62	.00	J
9GY	A	6240002484280	EA	V	-	69.44	.00	.00	.00	006	0.0	2.48	.00	32.24	.00	O
9GV	A	6240002148861	EA		Y	310.50	.00	.00	.00	006	0.0	3.45	.00	272.55	.00	H
9GD	A	7310011026271	EA	N	S-	5391.64	.00	.00	.00	006	0.1	366.28	.00	732.56	.00	B
9GD	A	5977006498764	EA		-	105.58	.00	.00	.00	006	0.6	4.17	.00	137.61	.00	J
9GD	A	6130011015891	EA			11322.48	.00	.00	.00	008	0.7	1887.08	.00	1887.08	.00	A
9GD	A	6605001179767	EA			2339.62	.00	.00	.00	006	0.0	958.86	.00	958.86	.00	D
9GD	A	5975002806083	EA		-	23.50	.00	.00	.00	006	0.5	.94	.00	31.96	.00	J
9GD	A	6650011146619	EA			275.00	.00	.00	.00	008	1.0	1.10	.00	338.80	.00	I
9GD	A	4140007587424	EA			2401.94	.00	.00	.00	006	1.0	196.88	.00	1181.28	.00	D
9GV	A	4130001275228	EA		W	1483.86	.00	.00	.00	006	0.6	247.31	.00	494.62	.00	E
9GY	A	6210010168684	EA		Y	118.85	.00	.00	.00	006	1.2	18.57	.00	185.70	.00	J
9GD	A	6115000433975	EA		-	7798.63	.00	.00	.00	006	0.4	1107.76	.00	1107.76	.00	B
9GV	A	6210005480228	EA		Y	320.32	.00	.00	.00	006	0.0	7.28	.00	262.08	.00	H

Figure 13 Sample Group 5 Listing

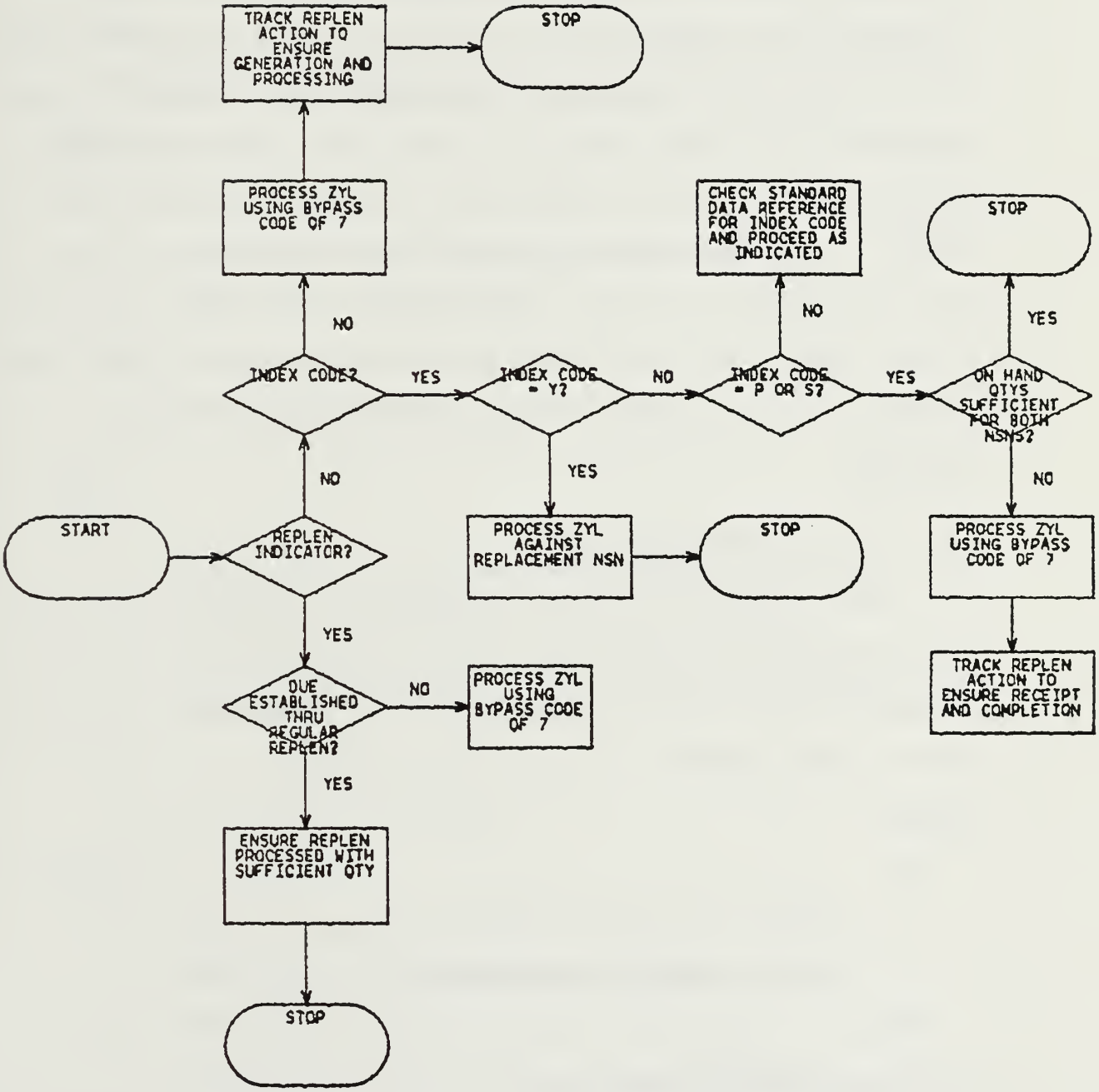

Figure 14 Group 5 Processing

be procured. No replenishment can be initiated against the superseded NSN so any buys are processed against the replacement item. Index codes of "P" or "S" basically denote that the NSN is interchangeable with another, but that no preferred/non-preferred relationships have been established. Both items could conceivably be stocked and procured. The quantity of on hand stock for either item (obtained from a MSIR inquiry), may be sufficient to cover the demand for both. A ZYL replenishment action is necessary only when the combined quantities are deficient. For those uncommon index codes other than those previously mentioned, the item manager consults manual references to determine how to proceed.

G. GROUP 5 DECISION RULES

The following decision rules are the essence of the expert's methods as described above in the Group 5 narrative. These decision rules can serve as the foundation for an expert system capable of Group 5 processing.

Rule 1

If:

1. There is a replenishment indicator, and
2. A due is being established,

Then:

No action is recommended.

Rule 2

If:

1. There is a replenishment indicator, and
2. No due is being established,

Then:

Process a ZYL using a 7 bypass code.

Rule 3

If:

1. There is no replenishment indicator, and
2. There is no index code,

Then:

Process a ZYL using a 7 bypass code.

Rule 4

If:

1. There is no replenishment indicator, and
2. There is an index code of P or S, and
3. The on hand stock for both NSNs is sufficient to cover the demand for each,

Then:

No action is recommended.

Rule 5

If:

1. There is no replenishment indicator, and
2. There is an index code of P or S, and
3. The on hand stock for one or both NSNs is deficient,

Then:

Process a ZYL using a 7 bypass code.

Rule 6

If:

1. There is no replenishment indicator, and

2. There is an index code other than Y, P, or S,

Then:

Refer to Standard Data Reference or request supervisory assistance.

Rule 7

If:

1. There is no replenishment indicator, and

2. There is an index code of Y,

Then:

Process a ZYL against the replacement NSN.

IV. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY AND CONCLUSIONS

The objective of this thesis has been to record the decision strategies used by retail stock point inventory managers in performing several limited job tasks. The reason for gathering this data is to use the decision rules in the development of a prototype expert system.

Chapters II and III have presented the rationales, methodologies, and decision rules followed by expert item managers in processing Delinquent Dues and Variable Ranking Lists. Although there was some initial diversity of opinion among the experts on minor parts of the two processes, a consensus was eventually reached on all issues. The item managers' professionalism and depth of knowledge was apparent in their enthusiastic review of the preliminary flowcharts and their articulate discussion of their jobs.

The interviews on which this research is based have revealed that Delinquent Dues processing is certainly the more complex of the two functions, and also the more signifcant in terms of supply support. But even so complex a process as Delinquent Dues, with its 33 decision rules, does not begin to compare in degree of complexity with some of the expert systems developed in other fields, with decision rules numbering in the hundreds. Indeed, whether what has

been recorded here can even come under the rubric of an expert system is a question that must be answered in the next stage of this research. There is little doubt, however, that a more automated method of performing these two job functions would pay large dividends, regardless of whether such an improvement could be rigorously classified as an expert system.

B. AREAS FOR FURTHER RESEARCH

The sequel to this research is the combining of the decision rules with commercial expert systems software, and the development of a prototype expert system for the item manager. If the value of such a system can be demonstrated, research can be expanded to other parts of the item manager's job, such as replenishment. This would require more detailed interviews and the recording of additional knowledge factors. Points of contact for possible future research at NSC San Diego are listed in the Appendix.

APPENDIX

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Armando Conde		958-3751/3624

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